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Makino et al.

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[54] **DOOR HINGE FOR VEHICLE**

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[52] **U.S. Cl.** **296/189**; 296/146.11; 16/221; 16/387

[58] **Field of Search** 296/188, 189, 296/146.1, 146.11; 16/221, 387

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[57] **ABSTRACT**

A door hinge is provided for a side-door of a vehicle whereby an impact applied to the side door in a direction transverse to the vehicle is absorbed at a connecting portion for connecting the side door to the body of the vehicle. The door hinge is comprised of a female and a male, and a connecting portion is provided uprightly on the male. Bearing portions are provided uprightly on the female, and the connecting portion and the bearing portions rotate relatively to each other with a shaft as a center of rotation. The connecting portion of the male is curved in such a manner as to protrude in the forward direction of the vehicle, and a point of application of a load and a support point in the male are offset from each other in the longitudinal direction of the vehicle. In a case where an impact load is applied to the side door from its outer side in the transverse direction of the vehicle, the connecting portion of the male becomes further curved in such a manner as to protrude further in the forward direction of the vehicle.

4 Claims, 7 Drawing Sheets

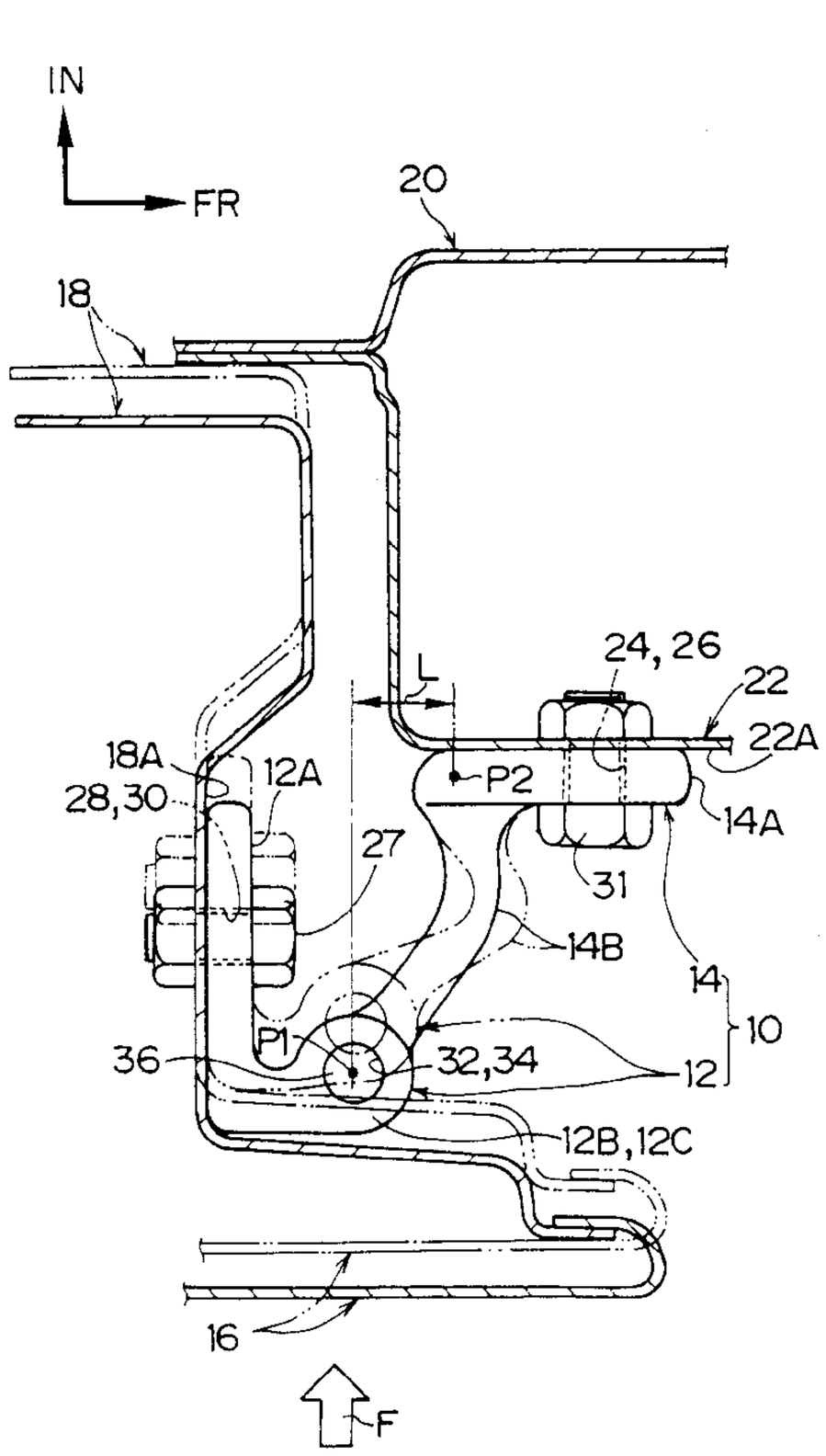

FIG. 1

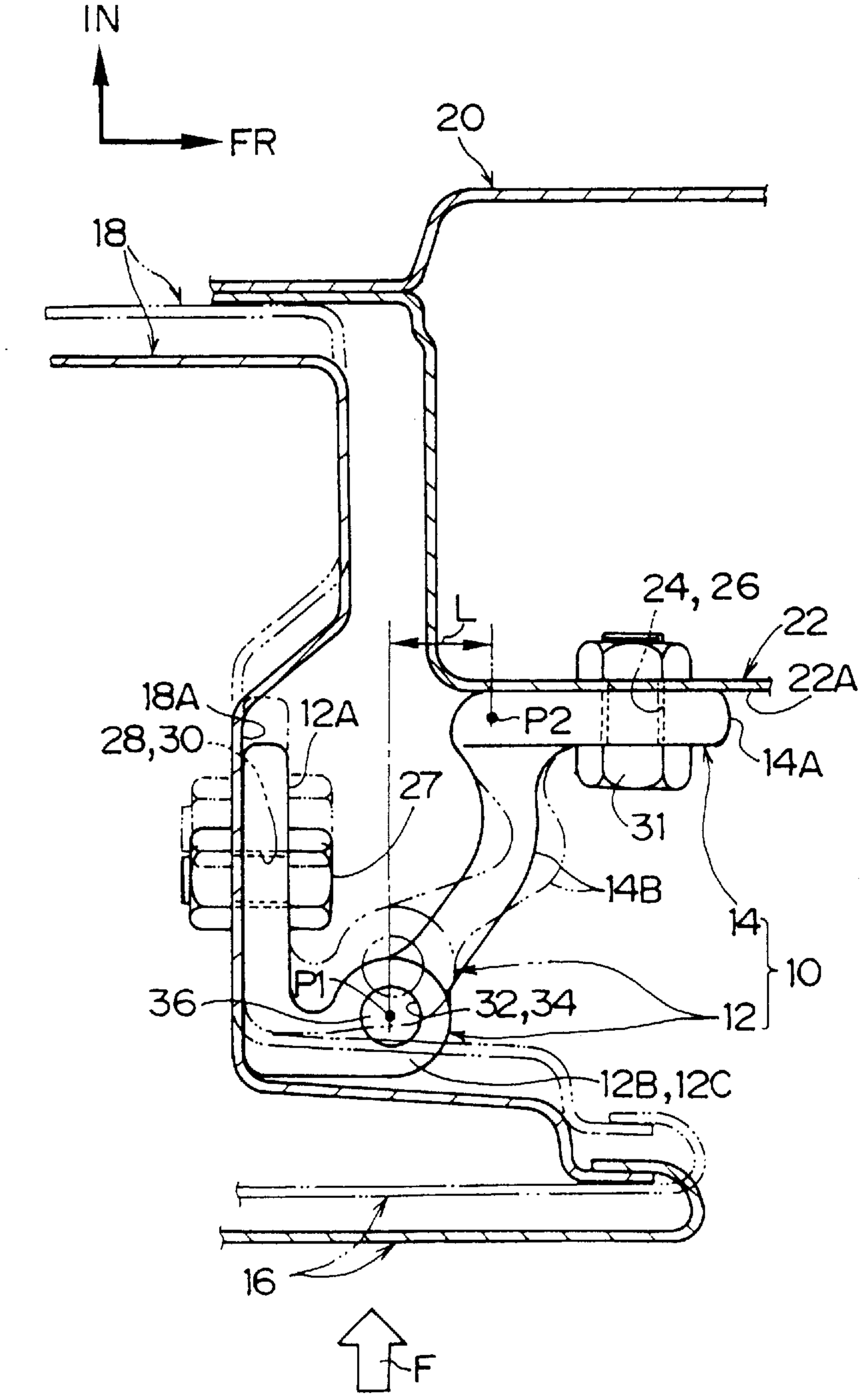
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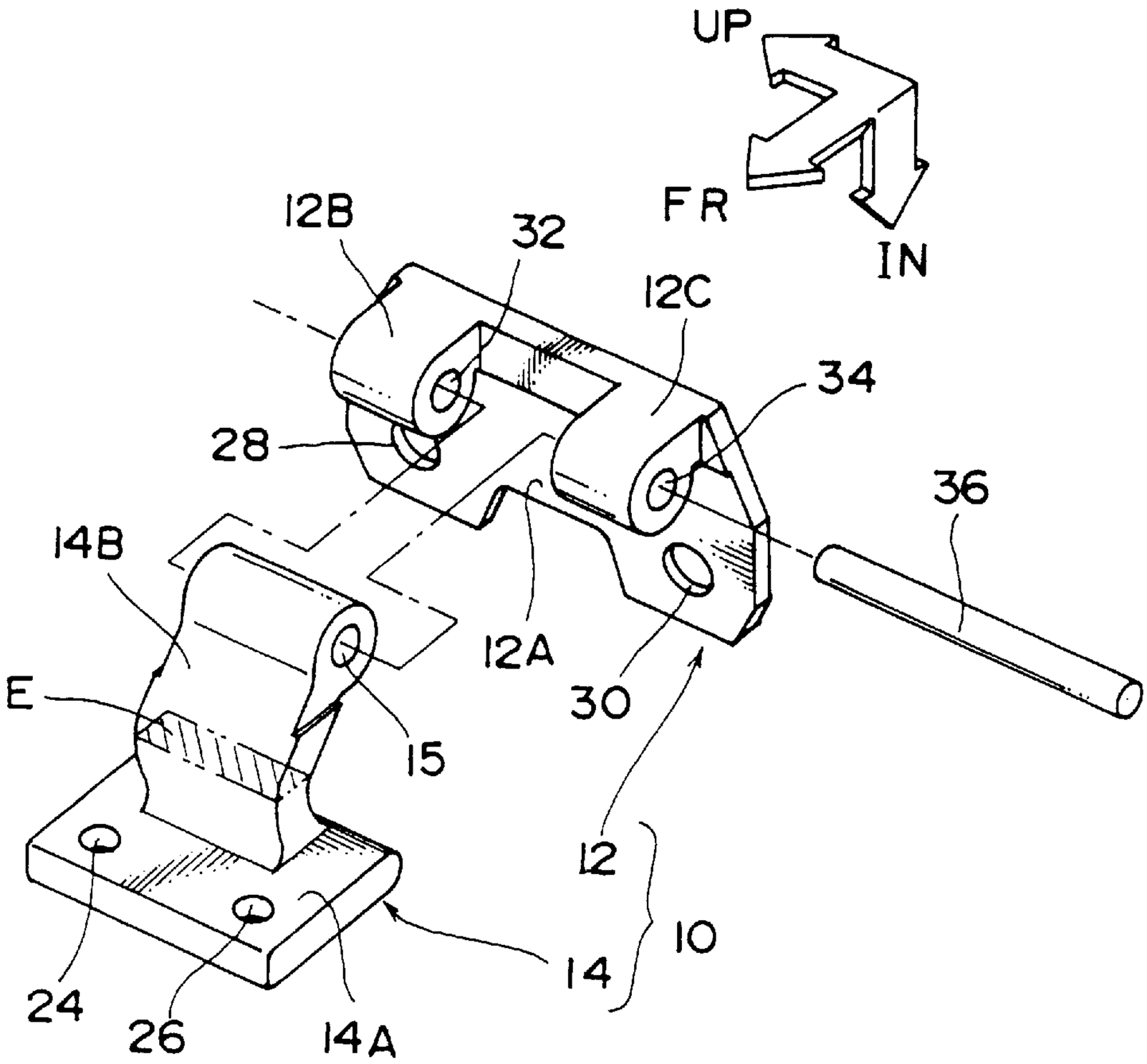
FIG. 2



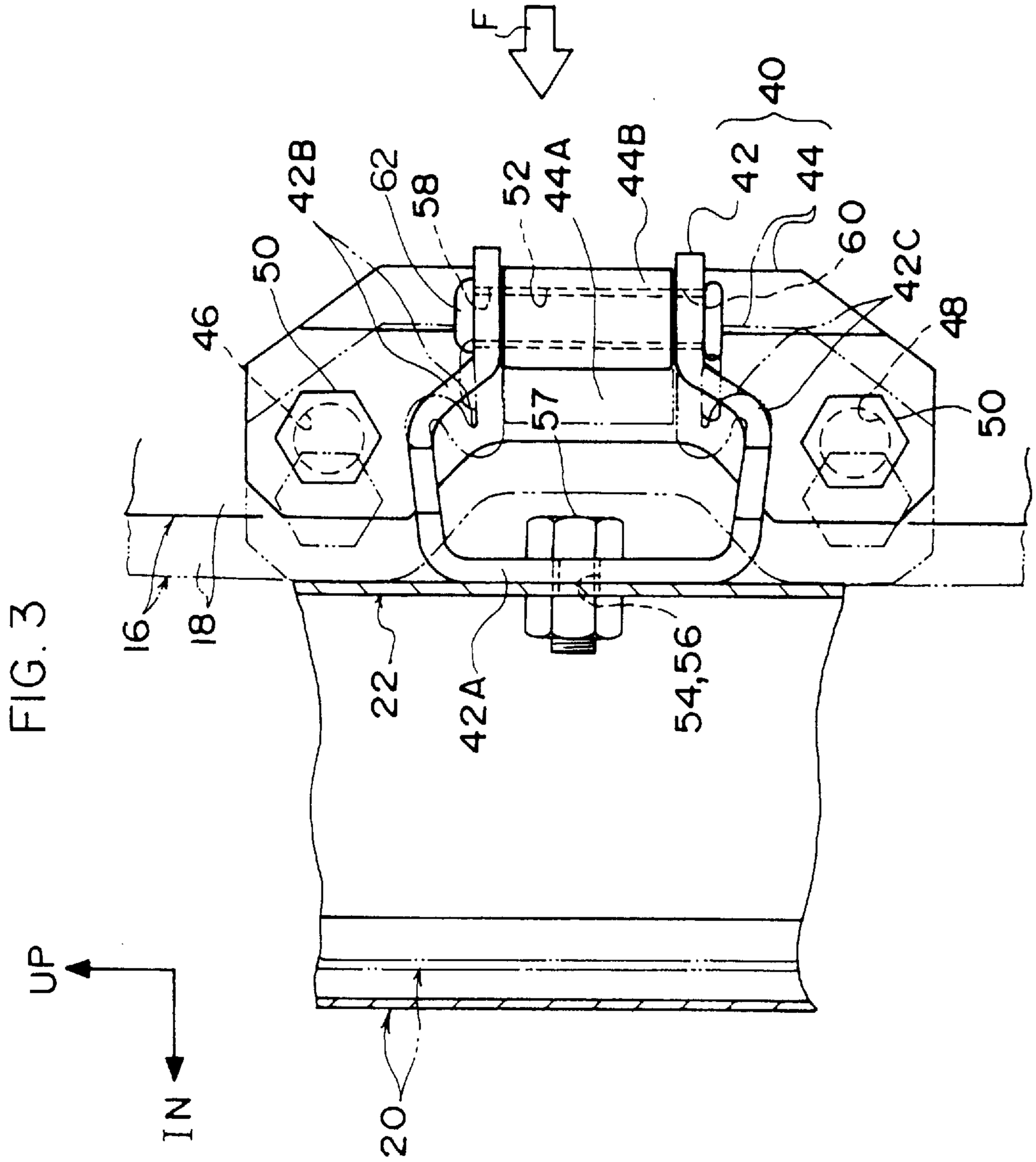

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FIG. 3

FIG. 4

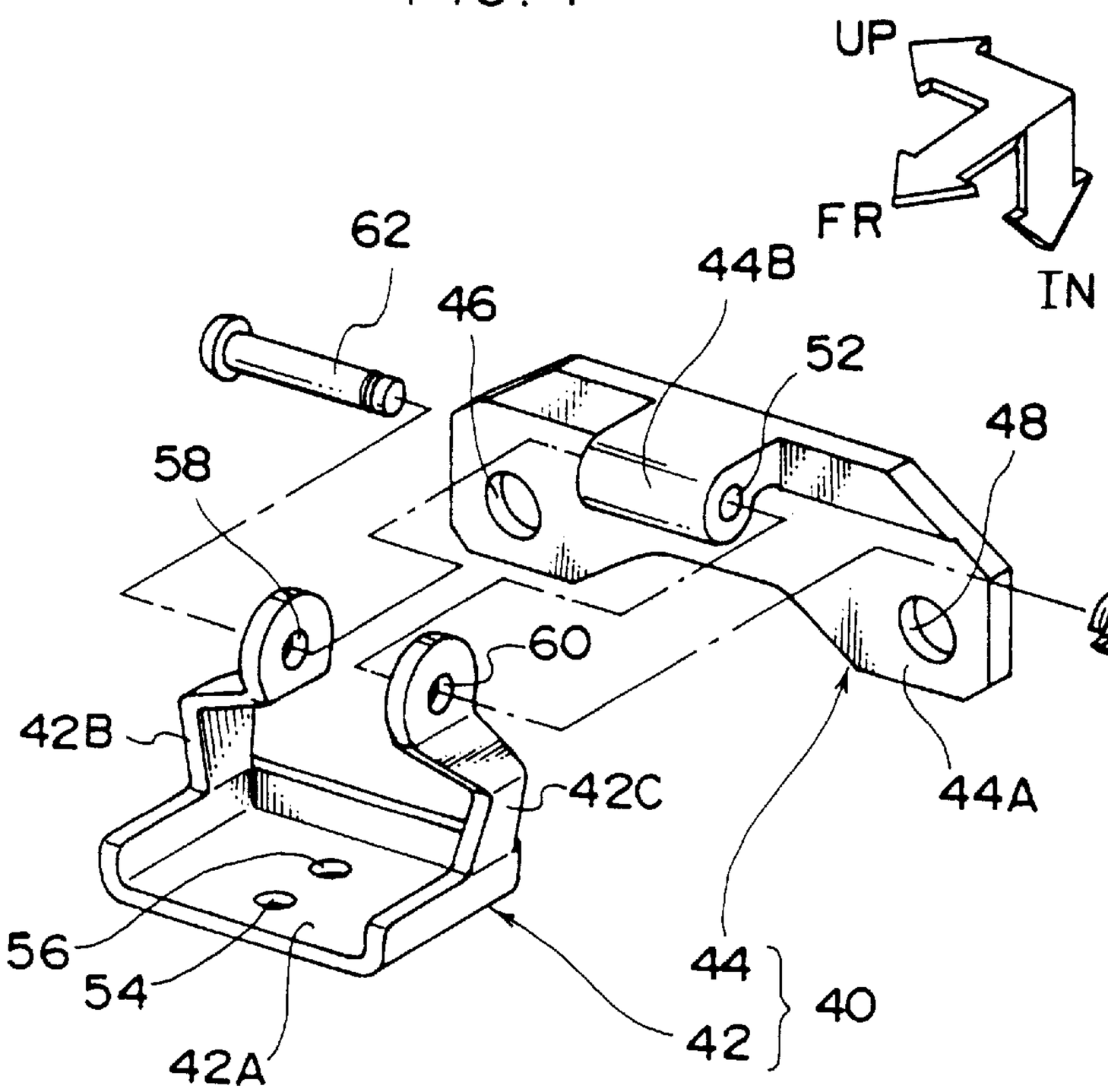
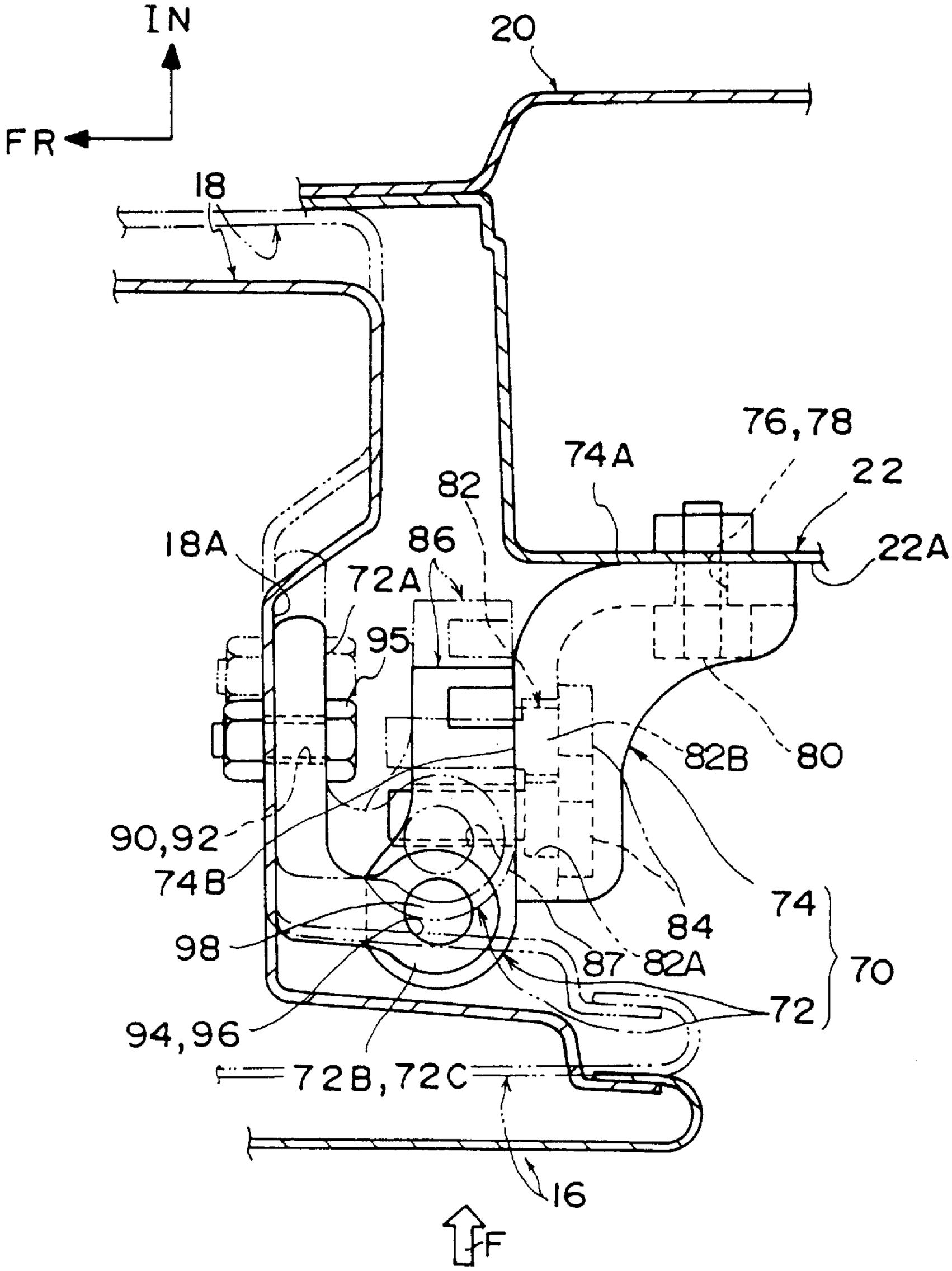


FIG. 5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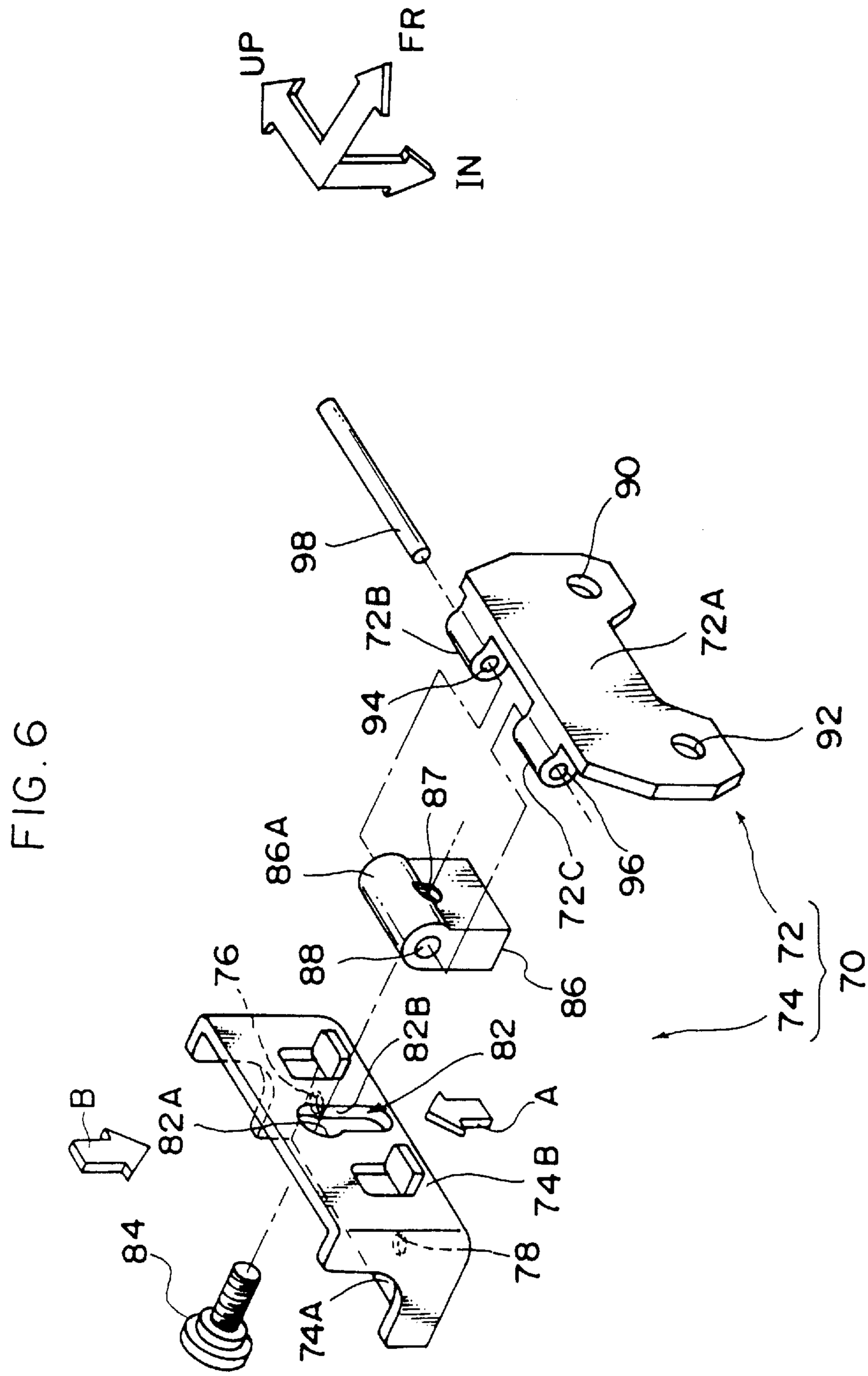
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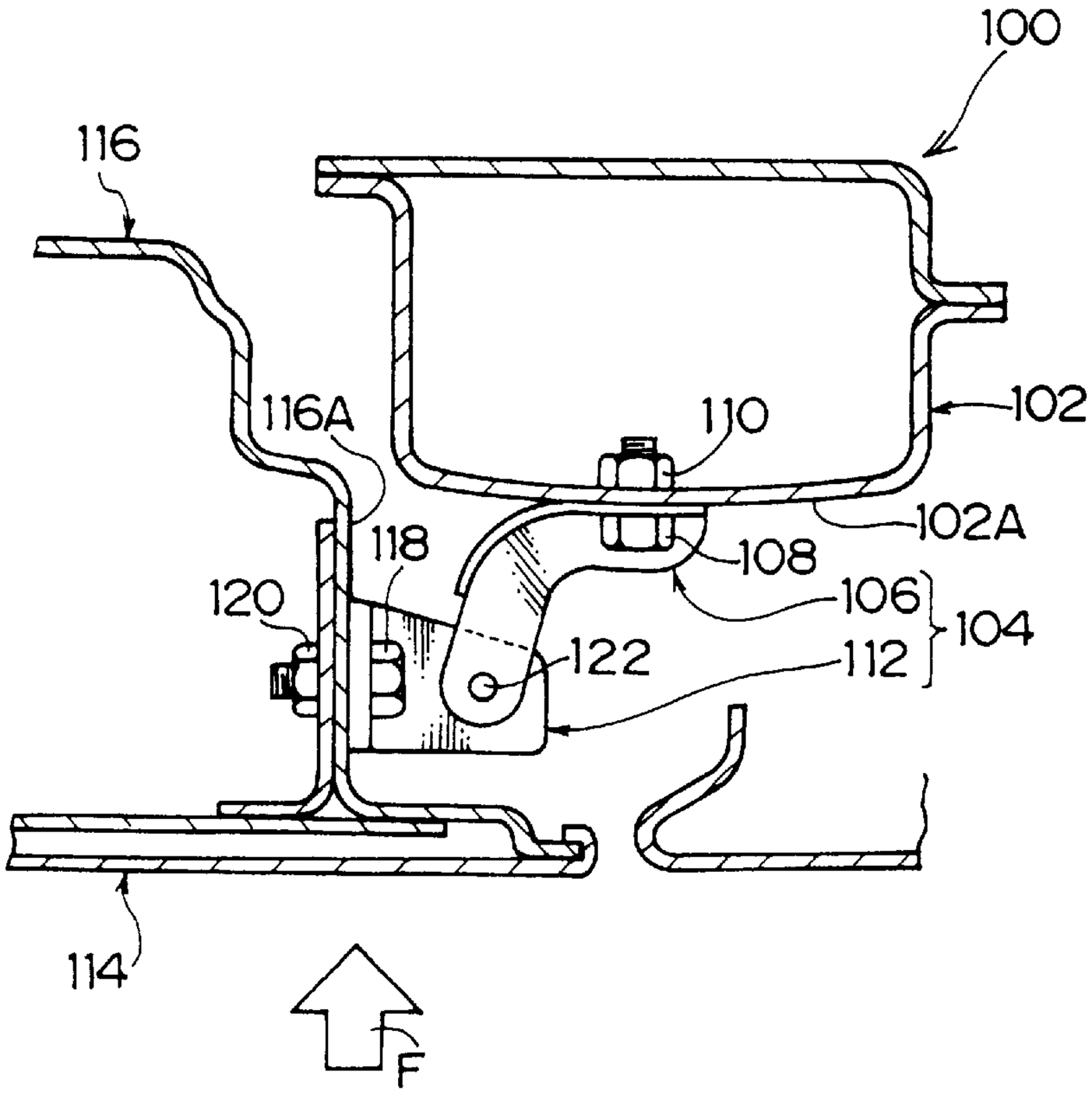
74A

FIG. 6

FIG. 7
PRIOR ART



DOOR HINGE FOR VEHICLE

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a door hinge for a vehicle, and more particularly to a door hinge for a vehicle which is provided with an impact absorbing capability.

2. Description of the Related Art

A conventional door hinge for a vehicle is generally constructed as shown in FIG. **7** (Japanese Patent Application Laid-Open No. 4-81322), in which a male **106** of a hinge **104** is secured to a vehicle outer side wall portion **102**A of an outer panel **102** of a pillar **100** by means of bolts **108** and nuts **110**. Further, a female **112** of the hinge **104** is secured to a vehicle front side wall portion **116**A of an inner panel **116** of a side door **114** by means of bolts **118** and nuts **120**. The male **106** and the female **112** of the hinge **104** are pivotally supported by means of a shaft **122**.

With such a door hinge **104** for a vehicle, however, in a case where an impact load is applied to the side door **114** from its outer side in the transverse direction of the vehicle (in the direction of arrow F in FIG. **7**), a structure is not provided for absorbing the impact by the hinge **104** at its connecting portion for connecting the pillar **100** and the side door **114**.

SUMMARY OF THE INVENTION

In view of the above-described circumstances, it is an object of the present invention to provide a door hinge for a vehicle whereby an impact applied to a side door of a vehicle in the transverse direction of the vehicle can be absorbed by the door hinge at its connecting portion for connecting a vehicle body and the door.

To this end, in accordance with a first aspect of the present invention, there is provided a door hinge for a vehicle for connecting a door to a vehicle body, comprising: an impact absorbing portion adapted to be deformed by an impact acting in a transverse direction of the vehicle so as to absorb the impact, the impact absorbing portion being provided at a connecting portion for connecting the vehicle body and the door.

Accordingly, if an impact is applied to the door in the transverse direction of the vehicle, the impact absorbing portion is deformed and absorbs the impact.

In accordance with a second aspect of the present invention, in the door hinge for a vehicle according to the first aspect of the invention, the door hinge is comprised of a hinge male and a hinge female, and the impact absorbing portion which is adapted to be deformed by the impact acting in the transverse direction of the vehicle so as to absorb the impact is provided on at least one of the hinge male and the hinge female.

Accordingly, if an impact is applied to the door in the transverse direction of the vehicle, the impact absorbing portion is deformed and absorbs the impact.

In accordance with a third aspect of the present invention, in the door hinge for a vehicle according to the second aspect of the invention, a point of application of a load and a support point of the impact absorbing portion are offset from each other, and the shape of a portion of the impact absorbing portion lying between the point of application of a load and the support point is curved in such a manner as to protrude in a direction away from the door.

Accordingly, if an impact is applied to the door in the transverse direction of the vehicle, the impact absorbing portion is deformed in a direction in which the impact absorbing portion does not interfere with the door, so as to absorb the impact.

In accordance with a fourth aspect of the present invention, in the door hinge for a vehicle according to the second aspect of the invention, the shape of the impact absorbing portion is curved in a vertical direction of the vehicle.

Accordingly, if an impact is applied to the door in the transverse direction of the vehicle, the impact absorbing portion becomes further curved in the vertical direction of the vehicle, and absorbs the impact.

In accordance with a fifth aspect of the present invention, in the door hinge for a vehicle according to the second aspect of the invention, the impact absorbing portion is constituted by a proximal portion, a hinge portion separated from the proximal portion, connecting means for connecting the hinge portion and the proximal portion, and a guide portion for guiding the connecting means during application of an impact and for relatively moving the hinge portion and the proximal portion in a direction in which the impact is absorbed.

Accordingly, if an impact is applied to the door in the transverse direction of the vehicle, the connecting means is guided by the guide portion, and the hinge portion and the proximal portion are relatively moved in the direction in the impact-absorbing direction, so as to absorb the impact.

The above and other objects, features and advantages of the present invention will become apparent from the following description and the appended claims, taken in conjunction with the accompanying drawings in which preferred embodiments of the present invention are shown by way of illustrative example.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will now be described with reference to the accompanying drawings wherein:

FIG. **1** is a horizontal cross-sectional view illustrating a door hinge for a vehicle in accordance with a first embodiment of the present invention;

FIG. **2** is a perspective view illustrating the door hinge for a vehicle in accordance with the first embodiment of the present invention;

FIG. **3** is a side cross-sectional view illustrating a door hinge for a vehicle in accordance with a second embodiment of the present invention;

FIG. **4** is a perspective view illustrating the door hinge for a vehicle in accordance with the second embodiment of the present invention;

FIG. **5** is a horizontal cross-sectional view illustrating a door hinge for a vehicle in accordance with a third embodiment of the present invention;

FIG. **6** is a perspective view illustrating the door hinge for a vehicle in accordance with the third embodiment of the present invention; and

FIG. **7** is a horizontal cross-sectional view illustrating a central pillar and a door hinge in accordance with the conventional art.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIGS. **1** and **2**, a description will be given of a first embodiment of a door hinge for a vehicle in accordance with the present invention. It should be noted that, in

the drawings, arrow FR denotes a forward direction of the vehicle; arrow UP denotes an upward direction of the vehicle; and arrow IN denotes a transversely inward direction of the vehicle.

As shown in FIG. **1**, a door hinge **10** for a vehicle in accordance with the first embodiment is comprised of a female **12** and a male **14**. The female **12** is secured to a vehicle front side vertical wall portion **18**A of a side door inner panel **18** which constitutes a vehicle compartment inner side portion of a side door **16**. Meanwhile, the male **14** is secured to a vehicle outer side vertical wall portion **22**A of a central pillar outer panel **22** which constitutes a vehicle outer side portion of a central pillar **20**.

As shown in FIG. **2**, a pair of attaching holes **24** and **26** are formed in an attaching portion **14**A of the male **14** in a vertical row at a predetermined interval therebetween. As shown in FIG. **1**, the male **14** is secured to the vehicle outer side vertical wall portion **22**A of the central pillar outer panel **22** by means of bolts **31** inserted in the attaching holes **24** and **26**. A connecting portion **14**B serving as an impact absorbing portion is provided uprightly on the attaching portion **14**A of the male **14**. The cross-sectional shape of the connecting portion **14**B is formed in a rectangular shape whose longitudinal direction is set as a vertical direction, as indicated by a hatched portion E in FIG. **2**. A through hole **15** is formed at a distal end portion of the connecting portion **14**B in such a manner as to extend in the vertical direction.

Meanwhile, a pair of attaching holes **28** and **30** are formed in an attaching portion **12**A of the female **12** in a vertical row at a predetermined interval therebetween. As shown in FIG. **1**, the female **12** is secured to the vehicle front side vertical wall portion **18**A of the side door inner panel **18** by means of bolts **27** inserted in the attaching holes **28** and **30**. A vertical pair of bearing portions **12**B and **12**C are provided uprightly on the attaching portion **12**A of the female **12**. Through holes **32** and **34** are respectively formed in the bearing portions **12**B and **12**C in such a manner as to extend in the vertical direction.

A shaft **36** is inserted in the through hole **15** of the male **14** and the through holes **32** and **34** of the female **12**. The arrangement provided is such that the male **14** and the female **12** rotate relative to each other with this shaft **36** as a center of rotation, so as to open or close the side door **16**.

As shown in FIG. **1**, the center of the through hole **15** of the connecting portion **14**B serves as a point P1 of application of a load, while a basal portion of the connecting portion **14**B serves as a support point P2. The point P1 of application of a load and the support point P2 are offset from each other (with an offset amount L) in the longitudinal direction of the vehicle, and a portion of the connecting portion **14**B lying between the point P1 of application of a load and the support point P2 is curved in a direction away from the vehicle front side vertical wall portion **18**A of the side door inner panel **18**, i.e., in such a manner as to protrude toward the front side of the vehicle.

Accordingly, in the event that an impact load is applied to the side door **16** from its outer side in the transverse direction of the vehicle (in the direction of arrow F in FIG. **1**), the connecting portion **14**B of the male **14** is pressed and becomes further curved in such a manner as to protrude further in the forward direction of the vehicle, as shown by the phantom lines in FIG. **1**.

Next, a description will be given of the operation of the first embodiment.

With the door hinge **10** for a vehicle in accordance with the first embodiment, in a case where an impact load is applied to the side door **16** from its outer side in the transverse direction of the vehicle (in the direction of arrow F in FIG. **1**), the connecting portion **14**B of the male **14** is pressed and becomes further curved in such a manner as to protrude further in the forward direction of the vehicle, as shown by the phantom lines in FIG. **1**. Consequently, the side door **16** moves toward the inner side in the transverse direction of the vehicle, and assumes the position indicated by the phantom lines in FIG. **1**.

In the above-described manner, with the door hinge **10** for a vehicle in accordance with the first embodiment, in a case where an impact load is applied to the side door **16** from its outer side in the transverse direction of the vehicle, the connecting portion **14**B of the male **14** is deformed in a direction in which the connecting portion **14**B does not interfere with the vehicle front side vertical wall portion **18**A of the side door inner panel **18**. Hence, the impact can be absorbed reliably by this deformation.

Next, referring to FIGS. **3** and **4**, a description will be given of a second embodiment of the door hinge for a vehicle in accordance with the present invention. Incidentally, the same component parts as those of the first embodiment will be denoted by the same reference numerals, and a description thereof will be omitted.

As shown in FIG. **3**, a door hinge **40** for a vehicle in accordance with the second embodiment is comprised of a female **42** and a male **44**. A pair of attaching holes **46** and **48** are formed in an attaching portion **44**A of the male **44** in a vertical row at a predetermined interval therebetween. The male **44** is secured to the side door inner panel **18** by means of bolts **50** inserted in the attaching holes **46** and **48**. Further, a bearing portion **44**B is provided uprightly on the attaching portion **44**A of the male **44**, and a through hole **52** is formed in the bearing portion **44**B in such a manner as to extend in the vertical direction.

As shown in FIG. **4**, a pair of attaching holes **54** and **56** are formed in an attaching portion **42**A of the female **42** at a predetermined interval therebetween in the longitudinal direction of the vehicle. As shown in FIG. **3**, the female **42** is secured to the central pillar outer panel **22** by means of bolts **57** inserted in the attaching holes **54** and **56**. A vertical pair of connecting portions **42**B and **42**C serving as impact absorbing portions are provided uprightly on the attaching portion **42**A of the female **42**. Through holes **58** and **60** are respectively formed at distal end portions of the connecting portions **42**B and **42**C.

A shaft **62** is inserted in the through hole **52** of the male **44** and the through holes **58** and **60** of the female **42**. The arrangement provided is such that the male **44** and the female **42** rotate relative to each other with this shaft **62** as a center of rotation, so as to open or close the side door **16**.

As shown in FIG. **3**, the connecting portion **42**B of the female **42** is inclined in a diagonally downward direction of the vehicle from an intermediate portion thereof toward a distal end portion thereof (on the right-hand side in FIG. **3**). On the other hand, the connecting portion **42**C of the female **42** is inclined in a diagonally upward direction of the vehicle from an intermediate portion thereof toward a distal end portion thereof (on the right-hand side in FIG. **3**).

Accordingly, in the event that an impact load is applied to the side door **16** from its outer side in the transverse direction of the vehicle (in the direction of arrow F in FIG. **3**), the connecting portions **42**B and **42**C of the female **42** are bent in such a manner as to protrude toward the outer side of the vehicle, as shown by the phantom lines in FIG. **3**.

Next, a description will be given of the operation of the second embodiment.

With the door hinge **40** for a vehicle in accordance with the second embodiment, in a case where an impact load is applied to the side door **16** from its outer side in the transverse direction of the vehicle (in the direction of arrow F in FIG. **3**), the connecting portions **42**B and **42**C of the female **42** are bent in such a manner as to protrude toward the outer side of the vehicle, as shown by the phantom lines in FIG. **3**. Consequently, the side door **16** moves toward the inner side in the transverse direction of the vehicle, and assumes the position indicated by the phantom lines in FIG. **3**.

In the above-described manner, with the door hinge **40** for a vehicle in accordance with the second embodiment, in a case where an impact load is applied to the side door **16** from its outer side in the transverse direction of the vehicle, the connecting portions **42**B and **42**C of the female **42** are deformed in a direction in which the connecting portions **42**B and **42**C do not interfere with the side door inner panel **18**. Hence, the impact can be absorbed reliably by this deformation.

Next, referring to FIGS. **5** and **6**, a description will be given of a third embodiment of the door hinge for a vehicle in accordance with the present invention. Incidentally, the same component parts as those of the first embodiment will be denoted by the same reference numerals, and a description thereof will be omitted.

As shown in FIG. **5**, a door hinge **70** for a vehicle in accordance with the third embodiment is comprised of a female **72** and a male **74**. A pair of attaching holes **76** and **78** are formed in an attaching portion **74**A of the male **74** in a vertical row at a predetermined interval therebetween. The male **74** is secured to the vehicle outer side vertical wall portion **22**A of the central pillar outer panel **22** by means of bolts **80** inserted in the attaching holes **76** and **78**.

As shown in FIG. **6**, a proximal portion **74**B serving as a part of the impact absorbing portion is provided uprightly on the attaching portion **74**A of the male **74**, and an elongated hole **82** serving as a guide portion extending in the transverse direction of the vehicle is formed in a central portion of the proximal portion **74**B. An outer side, as viewed in the transverse direction of the vehicle, of the elongated hole **82** serves as a bolt attaching portion **82**A, while an inner side, as viewed in the transverse direction of the vehicle, of the elongated hole **82** serves as a narrow guide slit **82**B.

A stepped screw **84** serving as a connecting means is inserted in the bolt attaching portion **82**A of the elongated hole **82**, and the stepped screw **84** is threadedly engaged in a threaded hole **87** formed in a hinge portion **86**. It should be noted that the hinge portion **86** is formed separately from the male **74**, and together with the proximal portion **74**B constitutes an impact absorbing portion.

Accordingly, the arrangement provided is such that in a case where a load of a predetermined value or more is applied to the male **74** and the hinge portion **86** in the transverse direction of the vehicle (in the directions arrows A and B in FIG. **6**), the stepped screw **84** and the guide slit **82**B move relative to each other, so that the male **74** and the hinge portion **86** move relative to each other in the transverse direction of the vehicle.

In addition, a through hole **88** is formed in a distal end portion **86**A of the hinge portion **86** in such a manner as to extend in the vertical direction.

Meanwhile, a pair of attaching holes **90** and **92** are formed in an attaching portion **72**A of the female **72** in a vertical row at a predetermined interval therebetween. The female **72** is secured to the vehicle front side vertical wall portion **18**A of the side door inner panel **18** by means of bolts **95** inserted in the attaching holes **90** an **92**, as shown in FIG. **5**.

Further, a vertical pair of bearing portions **72**B and **72**C are provided uprightly on the attaching portion **72**A of the female **72**, and through holes **94** and **96** are respectively formed on the bearing portions **72**B and **72**C in such a manner as to extend in the vertical direction.

A shaft **98** is inserted in the through hole **88** of the hinge portion **86** of the male **74** and the through holes **94** and **96** of the bearing portions **72**B and **72**C of the female **72**, and the male **74** and the female **72** rotate relative to each other with the shaft **98** as a center of rotation, so as to open or close the side door **16**.

Next, a description will be given of the operation of the third embodiment.

With the door hinge **70** for a vehicle in accordance with the third embodiment, in a case where an impact load is applied to the side door **16** from its outer side in the transverse direction of the vehicle (in the direction of arrow F in FIG. **5**), the stepped screw **84** and the guide slit **82**B move relative to each other, so that the male **74** and the hinge portion **86** move relative to each other in the transverse direction of the vehicle. Consequently, the side door **16** moves toward the inner side in the transverse direction of the vehicle, and assumes the position indicated by the phantom lines in FIG. **5**.

In the above-described manner, with the door hinge **70** for a vehicle in accordance with the third embodiment, in a case where an impact load is applied to the side door **16** from its outer side in the transverse direction of the vehicle, stepped screw **84** and the guide slit **82**B move relative to each other. Hence, the impact can be absorbed reliably by this movement.

Although, in the above description, specific embodiments of the present invention have been described in detail, the present invention is not limited to such embodiments, and it is apparent to those skilled in the art that various other embodiments are possible within the scope of the present invention. For example, an arrangement may be provided such that at least one of a male attaching portion for attaching a hinge male and a female attaching portion for attaching a hinge female is provided with an impact absorbing portion whereby at least one of the relative positions of the male attaching portion and the hinge male and the relative positions of the female attaching portion and the hinge female is changed due to an impact acting in the transverse direction of the vehicle, so as to absorb the impact.

What is claimed is:

1. A door hinge for a vehicle for connecting a door to a vehicle body, comprising:

an impact absorbing portion adapted to be deformed by an impact acting in a transverse direction of the vehicle so as to absorb the impact, said impact absorbing portion being provided at a connecting portion for connecting the vehicle body and the door,

wherein said door hinge comprises a hinge male and a hinge female, and said impact absorbing portion is provided on at least one of said hinge male and said hinge female, and

wherein one of said hinge male and said hinge female is secured to a vehicle outer side vertical wall portion of a central pillar outer panel which constitutes a vehicle outer side portion of a central pillar, while the other of said hinge male and said hinge female is secured to a vehicle front side vertical wall portion of a side door

inner panel which constitutes a vehicle compartment inner side portion of a side door.

2. A door hinge for a vehicle for connecting a door to a vehicle body, comprising:

a hinge male and a hinge female; and

an impact absorbing portion adapted to be deformed by an impact acting in a transverse direction of the vehicle so as to absorb the impact, said impact absorbing portion being provided on a least one of said hinge male and said hinge female

wherein a point of application of a load and a support point of said impact absorbing portion are offset from each other, and the shape of a portion of said impact absorbing portion lying between the point of application of a load and the support point is curved in such a manner as to protrude in a substantially transverse direction of the impact away from the door when deformed by the impact,

wherein one of said hinge male and said hinge female is secured to a vehicle outer side vertical wall portion of a central pillar outer panel which constitutes a vehicle outer side portion of a central pillar, while another one of said hinge male and said hinge female is secured to a vehicle front side vertical wall portion of a side door inner panel which constitutes a vehicle compartment inner side portion of a side door.

3. A door hinge for a vehicle according to claim **1**,

wherein the shape of said impact absorbing portion is curved in a vertical direction of the vehicle.

4. A door hinge for a vehicle according to claim **3**, wherein said impact absorbing portion is constituted by a pair of connecting portions which are provided on said hinge female in a vertical row for connecting to said hinge male, the shapes of said connecting portions being curved in the vertical direction of the vehicle.

* * * * *